REMARKS

A listing of all pending claims is provided above. Applicants address the grounds of rejection indicated in the Office Action in detail below. Reconsideration and allowance of the application are respectfully requested.

Allowed Claims

Applicants acknowledge with appreciation allowance of claims 10 and 11.

Allowable Subject Matter

The Office Action withdraws the allowability of claims 12 and 13, which was indicated in the previous Office Action, in view of U.S. Patent No. 6,248,642 of Dolan.

In response, Applicants note that the present application is a Continuation of U.S. Patent Application No. 09/339,633 that matured into the above Dolan patent. Thus, the Dolan patent is not prior art with respect to the present application. Accordingly, the rejections of claims 12 and 13 are improper.

Rejections Under 35 USC 103

The present invention relates to methods and systems for improving the quality of SIMOX wafers. It has been discovered by the present Applicants that the introduction of a background fluid into the vacuum chamber of an ion implantation system prior to exposure of the wafers to an oxygen ion beam can improve the quality of the silicon surface layer that remain following formation of a buried oxide region by ion implantation.

The Office Action rejects claims 1, 6-9 and 20-25 as being obvious in view of the combined teachings of U.S. Patent No. 6,313,014 of Sakaguchi and U.S. Patent No. 6,506,662 of Ogura. The Sakaguchi reference is apparently cited for its teachings of pretreatment processes for silicon wafers involving heating of the wafer in a hydrogen atmosphere *prior* to ion implantation. The Office Action acknowledges that Sakaguchi "fails to teach introducing a fluid other than molecular oxygen in a vacuum chamber as a background fluid" but asserts that Ogura et al. "teach dissociating water molecules (H_2O) in a plasma chamber to obtain positive ions; and

introducing said [hydrogen] ions into a reaction chamber where the substrate to be implanted is provided..." Applicants respectfully traverse these rejections for the following reasons.

Claim 1 recites a method of processing a silicon substrate by evacuating a vacuum chamber in which the substrate is placed to a first pressure, and introducing a fluid other than molecular oxygen into the vacuum chamber as a background fluid. *Subsequently*, ions are implanted into the substrate, in the *presence of the background fluid*, to form a buried oxide layer under a top silicon layer, wherein the fluid inhibits formations of threading dislocations in the top silicon layer for reducing a defect density of the processed substrate.

As discussed below, neither Sakaguchi nor Ogura teaches introducing a fluid into an ion implantation chamber as a *background fluid*, and *subsequently*, implanting the substrate with ions *while the background fluid is present*. More specifically, Sakaguchi discloses a method for fabricating an SOI substrate by initially heat-treating a silicon substrate in a reducing atmosphere containing hydrogen. The substrate is then subjected to ion implantation and an annealing process to generate therein a buried oxide (BOX) layer. Sakaguchi also teaches *post implantation* annealing in a hydrogen atmosphere. Notably absent, however, is any suggestion of performing the ion implantation step in the presence of the hydrogen-containing atmosphere.

Likewise, Ogura fails to teach implanting ions in a substrate in the presence of a background fluid. More particularly, Ogura describes a method for generating a silicon-on-insulator substrate by utilizing an apparatus that includes a plasma chamber in which oxygen and/or nitrogen ions are generated by plasma dissociation of molecules containing oxygen and/or nitrogen. A dilution gas, e.g., H_2 or He, can be optionally added to the plasma chamber to dilute the nitrogen and/or oxygen containing molecules. A plurality of acceleration electrodes accelerate the generated ions towards a *separate* reaction chamber so as to bombard a silicon substrate placed in that chamber.

Ogura does not teach introducing a background fluid into the reaction chamber and subsequently directing ions onto the silicon substrate in the presence of this background gas. The Examiner's reference to certain passages in Ogura (i.e., col. 3, lines 60-65, col. 4, lines 1-4, col. 8, line 61 – col. 9, line 2 and col. 9, lines 54-62) as teaching such a background fluid is

completely misplaced. These passages refer to adding a dilution gas to the *plasma* chamber for enhancing generation of ions, and not to adding fluid to a reaction chamber before ion implantation. In fact, the following passage of Ogura (col. 7, lines 11-21) clearly indicates that it is important that the plasma chamber be separated from the reaction chamber:

> It is important that the plasma vacuum container 10 and the reaction chamber 30 are separated by the acceleration electrodes 20 to control the acceleration energy of ions so as to obtain an abrupt interface of the insulation film to the silicon layer overlying the insulation film. Contrary to the present invention, if the silicon substrate is, placed in the plasma chamber as used in the plasma doping process, it is difficult to control the energy of the accelerated ions thereby resulting in difficulty in obtaining an abrupt interface of the insulation film to the silicon layer overlying the insulation film.

Further, the ions bombarding the substrate in Ogura cannot themselves be considered a background fluid as this term is used in the claims. The Examiner states that "there is not description in the rejected claims that the fluid other than oxygen has to be different from the ion beam." Applicants strongly disagree. Claim 1 expressly recites that the ion implantation is performed *subsequent* to the introduction of the background fluid. Such a temporal distinction would be meaningless if the ions were themselves the background fluid. In addition, claim 1 recites that "the fluid inhibits formations of threading dislocations in the top silicon layer for reducing a defect density of the processed substrate." There is no indication in the specification that the implanted ions themselves can reduce a defect density of the processed substrate.

In sum, neither Sakaguchi nor Ogura teaches or suggests implanting ions in a semiconductor substrate in the presence of a background fluid, introduced into a chamber in which the substrate is placed prior to commencement of ion implantation.

Thus, claim 1, and claims 6-9 that depend on claim 1, distinguish patentably over the combined teachings of Sakaguchi and Ogura. Similarly, independent claims 20, 22, and 24 (and claims 21, 23 and 25 depending on these claims) are patentable over the combined teachings of Sakaguchi and Ogura. In particular, similar to claim 1, each of these independent method claims

recites introducing a background fluid into a evacuated chamber in which a silicon substrate is placed followed by implanting ions in the substrate in the presence of the background fluid.

CONCLUSION

In view of the above remarks, Applicants respectfully request reconsideration and allowance of the application. Applicants invite the Examiner to call the undersigned at (617) 439-2514.

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Respectfully submitted,

By _____

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